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Cyril VALADON

Attorney Docket No. 09826.0001-00000

ANNEXES TO THE
PRELIMINARY EXAMINATION REPORT
(ARTICLE 34 AMENDMENTS)

MAILSTOP PCT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

REQUEST FOR SUBSTITUTION OF REPLACEMENT SHEETS

Please substitute the attached replacement sheets 1-3A of the Article 34 Amendments for sheets 1-3 of the specification in the as-filed PCT application and replacement sheets 13-16 of the claims containing the Article 34 Amendments for sheets 13-15 of the claims in the enclosed as-filed PCT application. It is respectfully requested that the specification in the substitute sheets be examined during examination of the patent application. Claims 1-19, as amended, are cancelled in the Preliminary Amendment filed concurrently herewith and new claims 20-36 have been substituted therefor and are currently pending.

Respectfully submitted,

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Dated: May 9, 2005

By:


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FORMAT DETECTION

The invention relates to methods of, and apparatus for, determining which of a group of formats has been applied to an encoded signal that is capable of being decoded using the Viterbi algorithm. The Viterbi algorithm can be used to decode signals that have been encoded using, for example, a convolutional encoding scheme (recursive or non-recursive), a trellis code modulation (TCM) scheme or a multi-level coded modulation (MCM) scheme.

One of the major applications of the Viterbi algorithm is in the Universal Mobile Telecommunications System (UMTS) to decode signals that have been encoded to protect transmitted bits against errors.

In UMTS, a signal to be transmitted, comprising a stream of data bits, is formatted according to a transport format selected from amongst a group of available transport formats defined under the UMTS standard. When a signal is to be transmitted, it is transmitted as a series of blocks, each block being formatted in accordance with the selected transport format. Each transport format will accommodate a number of bits of the signal to be transmitted plus, amongst other things, a certain number of error checking bits. The identity of the transport format being employed may or may not be signalled to a unit receiving a transmitted signal. If no indication of the transport format is supplied to a unit receiving a transmitted signal, then the unit must determine the employed format itself in order to correctly decode the received signal.

One object of the invention is to provide a useful way of determining the format of a received communication signal, when said format is not explicitly signalled.

According to one aspect, the invention provides a method of assessing an encoded signal to locate a format in a plurality of candidate formats that was likely used to arrange the signal into blocks before the encoding was done, the method comprising performing a test on candidate formats in turn but refraining from testing further candidate formats once a candidate format passes the test, wherein the test determines whether or not a candidate

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format is likely to be the format used on the signal and the test, for a given candidate format, comprises using a Viterbi algorithm to determine trellis metrics for a point in said signal that would be an end point of a candidate block according to the given candidate format, determining from said metrics the likelihood of occupation at said point of an end state of an encoding scheme used to create the encoded signal, decoding a part of said signal ending at said point and performing a check using said decoded part to determine whether the candidate block satisfies an error protection scheme of the given candidate format.

The invention also consists in apparatus for assessing an encoded signal to locate a format in a plurality of candidate formats that was likely used to arrange the signal into blocks before the encoding was done, the apparatus comprising testing means for performing a test on candidate formats in turn and arranged to refrain from testing further candidate formats once a candidate format passes the test, wherein the test determines whether or not a candidate format is likely to be the format used on the signal and the testing means comprises calculating means for applying a Viterbi algorithm to determine trellis metrics for a point in said signal that would be an end point of a candidate block according to a given candidate format; assessing means for determining from said metrics the likelihood of occupation at said point of an end state of an encoding scheme used to create the encoded signal; decoding means for decoding a part of said signal ending at said point; and checking means for performing a check using said decoded part to determine whether the candidate block satisfies an error protection scheme of the given candidate format.

Thus, the invention provides a way of determining if a candidate format has been applied to an encoded signal.

In one embodiment, the determination of the likelihood of occupation of the termination state comprises comparing the metrics for the Viterbi trellis stage representing the candidate end point. Preferably, the likelihood of occupation is determined by way of comparing the maximum metric at the trellis stage representing the end point with the termination state metric at the same trellis stage. For example, the comparison of the maximum metric and the termination state metric can be carried out by normalising the

termination state metric and the maximum metric relative to the minimum metric at the Viterbi trellis stage representing the end point specified by the candidate format, and then comparing the normalised maximum metric to a quantity formed by multiplying the normalised termination state metric by a factor.

In one embodiment, the decoding of a part of the encoded signal finishing at the candidate end point is carried out only if there is sufficient likelihood of occupation of the encoding scheme's termination state at the candidate end point. In another embodiment, the decoding operation proceeds irrespective of the assessed likelihood of termination state occupation.

The invention involves checking to determine if a candidate block satisfies an error protection scheme used by the candidate format. In one embodiment, the candidate format comprises a data part and a checksum and the checking operation involves generating a corroborative checksum from the data part of the candidate block and also involves a comparison of the corroborative checksum with the checksum part of the candidate block. Preferably, the checksums are cyclic redundancy checksums, known as a CRCs.

In a preferred embodiment where the candidate block is expected to conform to a candidate format comprising a data part and a checksum part containing a checksum established on the data part, the extent of the decoded part of the encoded signal has an effect on how the check is done to determine whether the candidate block satisfies the error protection scheme of the candidate format. Where the decoded part contains the entirety of what should be the data part of the candidate block according to the candidate format, then a corroborative checksum is generated from the data part of the candidate block that is provided by the decoded part and the corroborative checksum is compared with the checksum part of the candidate block. Where the decoded part of the signal contains a portion only of the data part of the candidate block then a corroborative checksum is generated from the decoded portion of the data part using an intermediate checksum value as a starting point. The intermediate checksum value may be, for example, a value obtained by generating a checksum on the basis of a part of the encoded signal that was

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decoded at an earlier time in an assessment of whether another candidate format was the true format being used for the signal.

Amongst other things, the invention extends to format detection of received signals in basestations and subscriber units of wireless telecommunications networks.

By way of example only, some embodiments of the invention will now be described with reference to the accompanying figures, in which:

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CLAIMS

1. A method of assessing an encoded signal to locate a format in a plurality of candidate formats that was likely used to arrange the signal into blocks before the encoding was done, the method comprising performing a test on candidate formats in turn but refraining from testing further candidate formats once a candidate format passes the test, wherein the test determines whether or not a candidate format is likely to be the format used on the signal and the test, for a given candidate format, comprises using a Viterbi algorithm to determine trellis metrics for a point in said signal that would be an end point of a candidate block according to the given candidate format, determining from said metrics the likelihood of occupation at said point of an end state of an encoding scheme used to create the encoded signal, decoding a part of said signal ending at said point and performing a check using said decoded part to determine whether the candidate block satisfies an error protection scheme of the given candidate format.
2. A method according to claim 1, wherein the step of determining the likelihood of occupation of the end state comprises comparing the metrics at the end point.
3. A method according to claim 2, wherein the step of determining the likelihood of occupation of the end state comprises comparing the maximum metric at the end point with the end state metric at the end point.
4. A method according to any one of claims 1 to 3, wherein the likelihood of occupation obtained from said metrics is used to determine whether said checking step is to be performed.
5. A method according to any one of claims 1 to 4, wherein the likelihood of occupation obtained from said metrics is used to determine whether said decoding step is to be performed.

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6. A method according to any one of claims 1 to 5, wherein the given candidate format specifies that the candidate block has a data part and a checksum part and the checking step comprises generating a corroborative checksum from a part of the candidate block that would be data according to the given candidate format and comparing the corroborative checksum with the said checksum part.
7. A method according to claim 6, wherein said decoded part contains said data part of the candidate block.
8. A method according to claim 6, wherein said decoded part contains a section only of said data part of the candidate block and the corroborative checksum is generated from said section using an intermediate checksum value as a starting point.
9. Apparatus for assessing an encoded signal to locate a format in a plurality of candidate formats that was likely used to arrange the signal into blocks before the encoding was done, the apparatus comprising testing means for performing a test on candidate formats in turn and arranged to refrain from testing further candidate formats once a candidate format passes the test, wherein the test determines whether or not a candidate format is likely to be the format used on the signal and the testing means comprises calculating means for applying a Viterbi algorithm to determine trellis metrics for a point in said signal that would be an end point of a candidate block according to a given candidate format; assessing means for determining from said metrics the likelihood of occupation at said point of an end state of an encoding scheme used to create the encoded signal; decoding means for decoding a part of said signal ending at said point; and checking means for performing a check using said decoded part to determine whether the candidate block satisfies an error protection scheme of the given candidate format.
10. Apparatus according to claim 9, wherein the assessing means is arranged to determine the likelihood of occupation of the end state by comparing metrics at the end point.

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11. Apparatus according to claim 10, wherein the assessing means is arranged to determine the likelihood of occupation of the end state by comparing the maximum metric at the end point with the end state metric at the end point.
12. Apparatus according to any one of claims 9 to 11, wherein the likelihood of occupation obtained from said metrics is used to determine whether said check is to be performed.
13. Apparatus according to any one of claims 9 to 12, wherein the likelihood of occupation obtained from said metrics is used to determine whether the decoding is to be performed by the decoding means.
14. Apparatus according to any one of claims 9 to 13, wherein the given candidate format specifies that the candidate block has a data part and a checksum part and the checking means is arranged to generate a corroborative checksum from a part of the candidate block that would be data according to the given candidate format and compare the corroborative checksum with said checksum part.
15. Apparatus according to claim 14, wherein said decoded part contains said data part of the candidate block.
16. Apparatus according to claim 14, wherein said decoded part contains a section only of said data part of the candidate block and the checking means is arranged to generate the corroborative checksum from said section using an intermediate checksum value as a starting point.
17. A program for causing data processing apparatus to perform the method of any one of claims 1 to 8.
18. Apparatus for assessing an encoded signal to determine whether a candidate format was used to arrange the signal into blocks before the encoding was done, the apparatus being substantially as hereinbefore described with reference to Figure 2 or 3.

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19. A method of assessing an encoded signal to determine whether a candidate format was used to arrange the signal into blocks before the encoding was done, the method being substantially as hereinbefore described with reference to Figure 2 or 3.

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